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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
DOTY, HEATHER ANNE	

ART UNIT	PAPER NUMBER
2813	

DATE MAILED: 10/31/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	10/665,267	GEORGE ET AL.
	Examiner	Art Unit
	Heather A. Doty	2813

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _30 August 2005_.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1-80_ is/are pending in the application.

4a) Of the above claim(s) _37-66,69-74 and 77-80_ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) _1-11,13-30,32-36,67,68,75 and 76_ is/are rejected.

7)☒ Claim(s) _12 and 31_ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on _17 September 2003_ is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _12/30/03,6/28/04_.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☒ Other: _IDS 11/30/04_.

DETAILED ACTION

Election/Restrictions

Applicant's election with traverse of claims 1-36, 75, and 76 in the reply filed on 30 August 2005 is acknowledged. The traversal is on the ground(s) that species I and II and species I and III contain overlapping subject matter and thus could be searched without placing undue burden on the examiner.

The argument that species I and II contain overlapping subject matter is not found persuasive because species I is drawn to a halogen-free plasma generated using a hydrocarbon gas in combination with oxygen and species II is drawn to a halogen-free plasma generated using a hydrogen-containing gas in combination with oxygen such that an overall gas mixture includes at least 15% hydrogen. Even though the hydrocarbon gas of species I is a hydrogen-containing gas, it is distinct from the hydrogen-containing gas of species II because species II requires the hydrogen-containing gas combined with oxygen includes at least 15% hydrogen, a limitation that requires additional searching.

However, Applicant's arguments regarding species III is persuasive because the gas used in combination with oxygen to produce at least one of CH_2 and CH_3 radicals of species III is generic to the hydrocarbon gas used in combination with oxygen to produce at least one of CH_2 and CH_3 radicals of species I. Therefore claims 67 and 68 are rejoined with species I.

The requirement for restriction of species I, II, and IV is still deemed proper and is therefore made FINAL.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless – (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-4, 9-11, 15, 20-23, 28-30, 32, 33, 67, and 68 are rejected under 35 U.S.C. 102(e) as being anticipated by Ho (U.S. 2002/0110992).

Regarding claim 1, Ho teaches a plasma reactor system for use in removing a process material crust (dielectric layer **318** in Fig. 3A) from a treatment object, comprising a treatment chamber within which a plasma is generated using a hydrocarbon gas in combination with oxygen gas (paragraph 0041) in a way which subjects the process material crust to the plasma for use in removal of the process material crust, said plasma being free of halogens, at least to an approximation (Ho expressly teaches the absence of fluorine in paragraph 0073, and additionally offers no reason to expect the presence of other halogens in any of the examples or descriptions of the etch chemistries).

Regarding claims 2-4, Ho teaches the system of claim 1 and further teaches that the hydrocarbon gas produces low-molecular-weight radicals, including a molecular weight of less than approximately 30—further limited by claim 3—in the plasma, wherein the low-molecular-weight radicals include at least one of CH_2 and CH_3 radicals—further limited by claim 4 (paragraph 0041; see also instant specification

paragraph 28, which lists CH_4, C_2H_4 and C_2H_6 as process gases that will produce CH_2 or CH_3 radicals).

Regarding claim 9, Ho teaches the system of claim 1, and further teaches that the treatment object is a semiconductor wafer (paragraph 0005).

Regarding claim 10, Ho teaches the system of claim 1, and further teaches that the hydrocarbon gas is in a range of from approximately 15% to 85% of an overall mixture with the oxygen gas (paragraph 0049).

Regarding claim 11, Ho teaches the system of claim 1, and further teaches that the hydrocarbon gas is methane (paragraph 0023).

Regarding claim 15, Ho teaches the system of claim 1, and further teaches including a parallel plate reactor for generating said plasma (paragraph 0054).

Regarding claim 20, Ho teaches, in a plasma reactor system at least for use in removing a process material crust (dielectric layer **318** in Fig. 3A) from a treatment object, a method comprising the steps of generating a plasma in a plasma chamber using a hydrocarbon gas in combination with oxygen gas (paragraph 0041) such that the plasma is halogen free (Ho expressly teaches the absence of fluorine in paragraph 0073, and additionally offers no reason to expect the presence of other halogens in any of the examples or descriptions of the etch chemistries), at least to an approximation, in a way which subjects the process material crust to the plasma for use in removal of the process material crust, and that the treatment chamber is a plasma chamber and said method is performed in a plasma reactor system (paragraph 0041).

Regarding claims 21-23, Ho teaches the method of claim 20, and further

teaches that the hydrocarbon gas produces low-molecular-weight radicals, including a molecular weight of less than approximately 30—further limited by claim 22—in the plasma, wherein the low-molecular-weight radicals include at least one of CH_2 and CH_3 radicals—further limited by claim 23 (paragraph 0041; see also instant specification paragraph 28, which lists CH_4, C_2H_4 and C_2H_6 as process gases that will produce CH_2 or CH_3 radicals).

Regarding claim 28, Ho teaches the method of claim 20, and further teaches that the treatment object is a semiconductor wafer (paragraph 0005).

Regarding claim 29, Ho teaches the method of claim 20, and further teaches that the hydrocarbon gas is in a range of from approximately 15% to 85% of an overall mixture with the oxygen gas (paragraph 0049).

Regarding claim 30, Ho teaches the method of claim 20, and further teaches that the hydrocarbon gas is methane (paragraph 0023).

Regarding claims 32 and 33, Ho teaches the method of claim 20, and further teaches the step of inducing power into the plasma at a power level of at least 500 W, and in a range from approximately 500 to 5000 W (paragraph 0054).

Regarding claim 67, Ho teaches a plasma reactor system at least for use in removing a process material crust (dielectric layer **318** in Fig. 3A) from a treatment object, said system comprising a treatment chamber within which a halogen-free plasma is generated using a gas in combination with oxygen gas in a way which produces at least one of CH_2 radicals and CH_3 radicals in said plasma to subject the process material crust to the plasma for use in removal of the process material crust

(paragraph 0041; see also instant specification paragraph 28, which lists CH_4, C_2H_4 and C_2H_6 as process gases that will produce CH_2 or CH_3 radicals).

Regarding claim 68, Ho teaches, in a plasma reactor system at least for use in removing a process material crust (dielectric layer **318** in Fig. 3A) from a treatment object, a method comprising the steps of generating a halogen-free plasma in a plasma chamber using a gas in combination with oxygen gas in a way which produces at least one of CH_2 radicals and CH_3 radicals in the plasma and which subjects the process material to the plasma for use in removal of the process material crust (paragraph 0041; see also instant specification paragraph 28, which lists CH_4, C_2H_4 and C_2H_6 as process gases that will produce CH_2 or CH_3 radicals).

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless - (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-9, 15, 16, 20-28, 67, 68, 75, and 76 are rejected under 35 U.S.C. 102(b) as being anticipated by Fukuyama et al. (U.S. 5,770,100).

Regarding claim 1, Fukuyama et al. teaches a system (Fig. 2) for use in removing a process material from a treatment object, comprising a treatment chamber (**8** in Fig. 2) within which a plasma is generated using a hydrocarbon gas in combination with oxygen in a way which subjects the process material crust to the plasma for use in removal of the process material crust (column 5, lines 30-64), said plasma being free of halogens, at least to an approximation (the treatment taught by Fukuyama et al. is

designed to *remove* halogens from the treatment object, so halogens would not be present in the plasma).

Regarding claims 2-4, Fukuyama et al. teaches the system of claim 1, and further teaches that the hydrocarbon gas produces low-molecular-weight radicals, including a molecular weight of less than approximately 30—further limited by claim 3—in the plasma, wherein the low-molecular-weight radicals include at least one of CH_2 and CH_3 radicals—further limited by claim 4 (methanol, CH_3OH—column 5, line 34; see also instant specification paragraph 28, which lists methanol as a process gas that will produce CH_2 or CH_3 radicals).

Regarding claim 5, Fukuyama et al. teaches the system of claim 1, and further teaches that said process material crust is formed by ion implantation of an original photoresist layer on a surface of said treatment object (column 1, lines 61-65).

Regarding claims 6 and 7, Fukuyama et al. teaches the system of claim 5, and further teaches that the process material crust overlies an unaltered region of said original photoresist layer (column 1, lines 61-65) and said plasma formed using said hydrocarbon gas in combination with oxygen is used to remove said unaltered region of photoresist, and the process material crust and the unaltered region of the original photoresist layer are removed simultaneously (column 5, line 59 - column 6, line 8).

Regarding claim 8, Fukuyama et al. teaches the system of claim 7, and further teaches that the plasma is generated with downstream plasma generation means (Fig 2; column 5, lines 30-58).

Regarding claim 9, Fukuyama et al. teaches the system of claim 1 and further

teaches that the treatment object is a semiconductor wafer (column 1, line 40; column 2, lines 49-52; **16** in Fig. 2).

Regarding claims 15 and 16, Fukuyama et al. teaches the system of claim 1 and further teaches including a parallel-plate reactor (column 7, lines 48-50) or a microwave plasma source (column 4, lines 43-59) for generating said plasma.

Regarding claim 20, Fukuyama et al. teaches, in a plasma reactor system at least for use in removing a process material crust from a treatment object, a method comprising the steps of generating a plasma in a treatment chamber using a hydrocarbon gas in combination with oxygen such that the plasma is halogen free (the treatment taught by Fukuyama et al. is designed to *remove* halogens from the treatment object, so halogens would not be present in the plasma), at least to an approximation, in a way which subjects the process material crust to the plasma for use in removal of the process material crust (column 5, lines 30-64).

Regarding claims 21-23, Fukuyama et al. teaches the method of claim 20, and further teaches that the hydrocarbon gas produces low-molecular-weight radicals, including a molecular weight of less than approximately 30—further limited by claim 22—in the plasma, wherein the low-molecular-weight radicals include at least one of CH_2 and CH_3 radicals—further limited by claim 23 (methanol, CH_3OH—column 5, line 34; see also instant specification paragraph 28, which lists methanol as a process gas that will produce CH_2 or CH_3 radicals).

Regarding claim 24, Fukuyama et al. teaches the method of claim 20 and further teaches that the process material is a photoresist and the process material crust is

formed by ion implantation of an original photoresist layer on a surface of the treatment object (column 1, lines 61-65).

Regarding claims 25 and 26, Fukuyama et al. teaches the method of claim 24, and further teaches that the process material crust overlies an unaltered region of said original photoresist layer (column 1, lines 61-65) and the method includes using said plasma to remove said unaltered region of photoresist, and the process material crust and the unaltered region of the original photoresist layer are removed simultaneously (column 5, line 59 - column 6, line 8).

Regarding claim 27, Fukuyama et al. teaches the method of claim 26, and further teaches downstream generation of said plasma (Fig. 2; column 5, lines 30-58).

Regarding claim 28, Fukuyama et al. teaches the method of claim 20, and further teaches that the treatment object is a semiconductor wafer (column 1, line 40; column 2, lines 49-52; **16** in Fig. 2).

Regarding claim 67, Fukuyama et al. teaches a plasma reactor system at least for use in removing a process material crust from a treatment object, said system comprising a treatment chamber within which a halogen-free plasma is generated using a gas in combination with oxygen gas in a way which produces at least one of CH_2 radicals and CH_3 radicals in said plasma to subject the process material crust to the plasma for use in removal of the process material crust (methanol, CH_3OH—column 5, line 34; see also instant specification paragraph 28, which lists methanol as a process gas that will produce CH_2 or CH_3 radicals).

Regarding claim 68, Fukuyama et al. teaches, in a plasma reactor system at

least for use in removing a process material crust from a treatment object, a method comprising the steps of generating a halogen-free plasma in a plasma chamber using a gas in combination with oxygen gas in a way which produces at least one of CH_2 radicals and CH_3 radicals in the plasma and which subjects the process material to the plasma for use in removal of the process material crust (methanol, CH_3OH—column 5, line 34; see also instant specification paragraph 28, which lists methanol as a process gas that will produce CH_2 or CH_3 radicals).

Regarding claim 75, Fukuyama et al. teaches a plasma reactor system at least for use in removing a process residue from a treatment object, which process residue is formed on the treatment object, at least in part as a result of removing an ion-implanted photoresist from the treatment object (column 1, lines 61-65), said system comprising a treatment chamber (**8** in Fig. 2) within which a plasma is generated using a hydrocarbon gas in combination with oxygen in a way which subjects the process material crust to the plasma for use in removal of the process material crust (column 5, lines 30-64), said plasma being free of halogens, at least to an approximation (the treatment taught by Fukuyama et al. is designed to *remove* halogens from the treatment object, so halogens would not be present in the plasma).

Regarding claim 76, Fukuyama et al. teaches, in a plasma reactor system at least for use in removing a process residue from a treatment object, which process residue is formed on the treatment object, at least in part as a result of removing an ion-implanted photoresist from the treatment object (column 1, lines 61-65), a method comprising generating a plasma in a treatment chamber using a hydrocarbon gas in

combination with oxygen such that the plasma is halogen free (the treatment taught by Fukuyama et al. is designed to *remove* halogens from the treatment object, so halogens would not be present in the plasma), at least to an approximation, in a way which subjects the process material crust to the plasma for use in removal of the process material crust (column 5, lines 30-64).

Claims 1, 17, 19, 20, 34, and 36 rejected under 35 U.S.C. 102(b) as being anticipated by Yoshihara et al. (U.S. 5,763,328).

Regarding claim 1, Yoshihara et al. teaches a plasma reactor system (Fig. 1) at least for use in removing a process material crust (photoresist, column 1, lines 51-60) from a treatment object, said system comprising a treatment chamber (**24** in Fig. 1) within which a plasma is generated using a hydrocarbon gas (methanol) in combination with oxygen gas (column 2, lines 28-42) in a way which subjects the process material crust to the plasma in a way which subjects the process material crust to the plasma for use in removal of the process material crust, said plasma being free of halogens, at least to an approximation (gas is *composed of* an oxygen gas and an alcohol gas, see MPEP 2111.03).

Regarding claims 17 and 19, Yoshihara et al. teaches the system of claim 1, and further teaches that the treatment chamber is at a pressure selected in the range of approximately 0.5 to 15 Torr, and at a pressure of approximately 1 Torr (Table 1).

Regarding claim 20, Yoshihara et al. teaches, in a plasma reactor system at least for use in removing a process material crust from a treatment object, a method comprising the steps of generating a plasma in a chamber using a hydrocarbon gas in

combination with oxygen gas (column 2, lines 27-42) such that the plasma is halogen free (gas is *composed of* an oxygen gas and an alcohol gas, see MPEP 2111.03), at least to an approximation, in a way which subjects the process material crust to the plasma for use in removal of the process material crust (column 1, lines 37-43 and 52-60).

Regarding claims 34 and 36, Yoshihara et al. teaches the method of claim 20, and further teaches that the treatment chamber is at a pressure selected in the range of approximately 0.5 to 15 Torr, and at a pressure of approximately 1 Torr (Table 1).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 18 and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yoshihara et al. (U.S. 5,763,328).

Regarding claims 18 and 35, Yoshihara et al. teaches the system of claim 1 and the method of claim 20 (note 35 U.S.C. 102(b) rejection above), but does not teach that the treatment chamber is at a pressure of approximately 3 Torr.

However, Yoshihara et al. teaches that the treatment chamber is above 2 Torr, and further discloses that the aluminum in the treatment object did not corrode when ashing was performed at a pressure greater than 1.6 Torr. Furthermore, it has been held that "where the general conditions of a claim are disclosed in the prior art, it is not

inventive to discover the optimum or workable ranges by routine experimentation." *In re Aller* 105 USPQ233, 255 (CCPA 1955).

Therefore, at the time of the invention, it would have been obvious to one of ordinary skill in the art to use the system of claim 1 or the method of claim 20, as taught by Yoshihara et al., and further set the pressure of the treatment chamber to approximately 3 Torr, since Yoshihara et al. teaches that it is advantageous to use pressures above 1.6 Torr in the ashing process.

Claims 13 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ho (U.S. 2002/0110992) in view of Wolf et al. (Silicon Processing for the VLSI Era, vol. 1, 2000).

Regarding claims 13 and 14, Ho teaches the system of claim 1 (note 35 U.S.C. 102(e) rejection above). Ho further teaches that the power level of the plasma is between 250 W to 2500 W (paragraph 0047), deemed by the examiner to be approximately 3000 W. Ho does not teach that an inductive coil induces power into the plasma.

Wolf et al. teaches that plasmas powered with inductive coils involves equipment that is simple to design, manufacture, and maintain compared to microwave-based plasma (pg. 708, section 14.8.3.3).

Therefore, at the time of the invention, it would have been obvious to one of ordinary skill in the art to modify the system taught by Ho, and also taught by claim 1, by using an inductive coil to power the plasma, at a power level of at least 200 W or approximately 3000 W. The motivation for doing so at the time of the invention would

have been because such powering a plasma by inductive coil involves equipment that is simple to design, manufacture, and maintain compared to microwave-based plasmas, as expressly taught by Wolf et al.

Allowable Subject Matter

Claims 12 and 31 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter: Prior art does not teach or suggest, in combination with the other claimed limitations, a halogen-free plasma generated using 75% methane and 25% oxygen.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Heather A. Doty whose telephone number is 571-272-8429. The examiner can normally be reached on M-F, 8:30 - 5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr. can be reached on 571-272-1702. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only.

For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

had

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PRIMARY EXAMINER